

# CSIS / JISEA / NREL

# Washington DC

## The Geopolitics of Clean Energy

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1<sup>st</sup> June 2011



**Bloomberg**  
NEW ENERGY FINANCE

# AGENDA

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1. Investment activity
2. Policy environment
3. Clean energy cost trends
4. The alternatives
5. Regional rivalry & geopolitics

# AGENDA

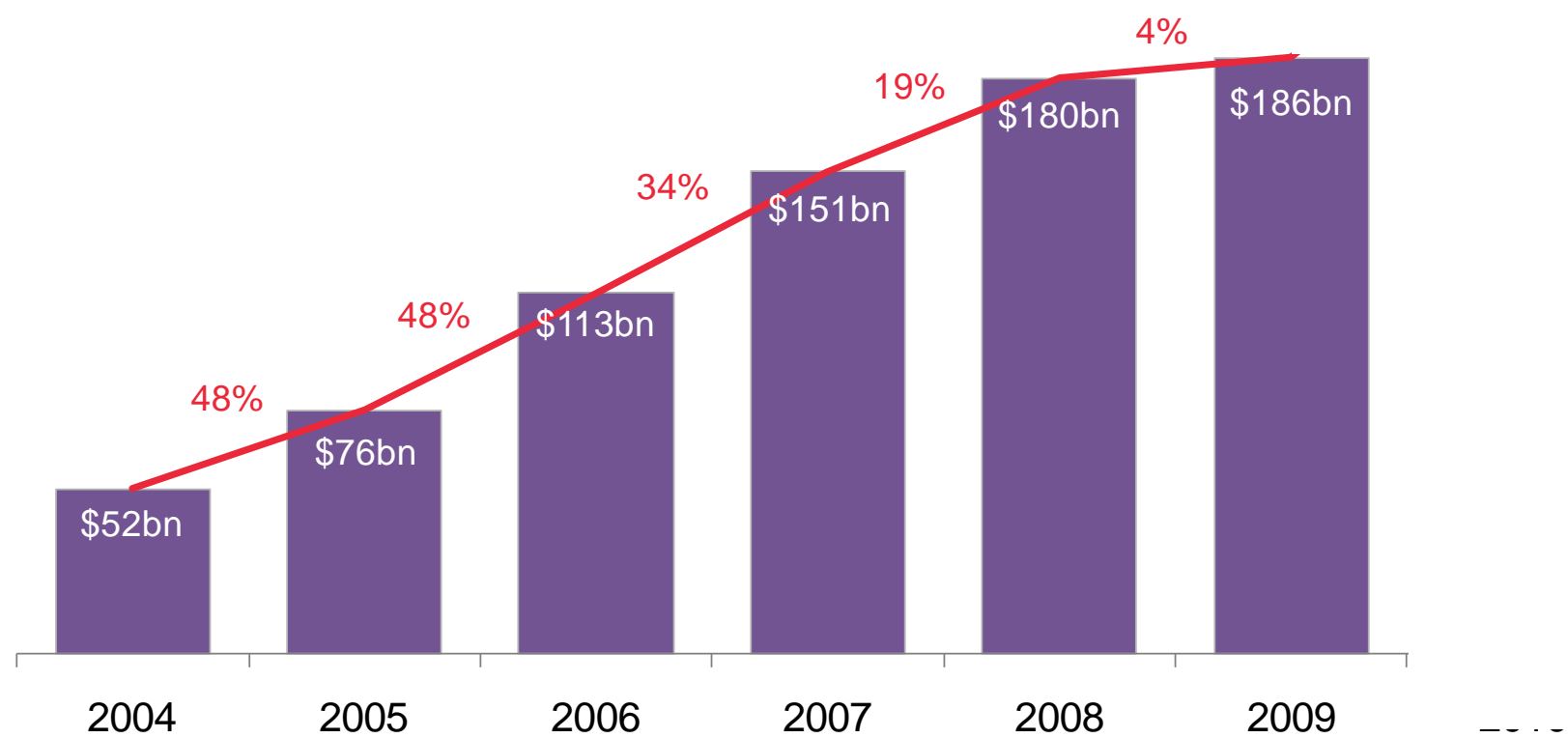
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# GLOBAL TOTAL NEW INVESTMENT IN CLEAN ENERGY

## 2004–10 (\$BN)

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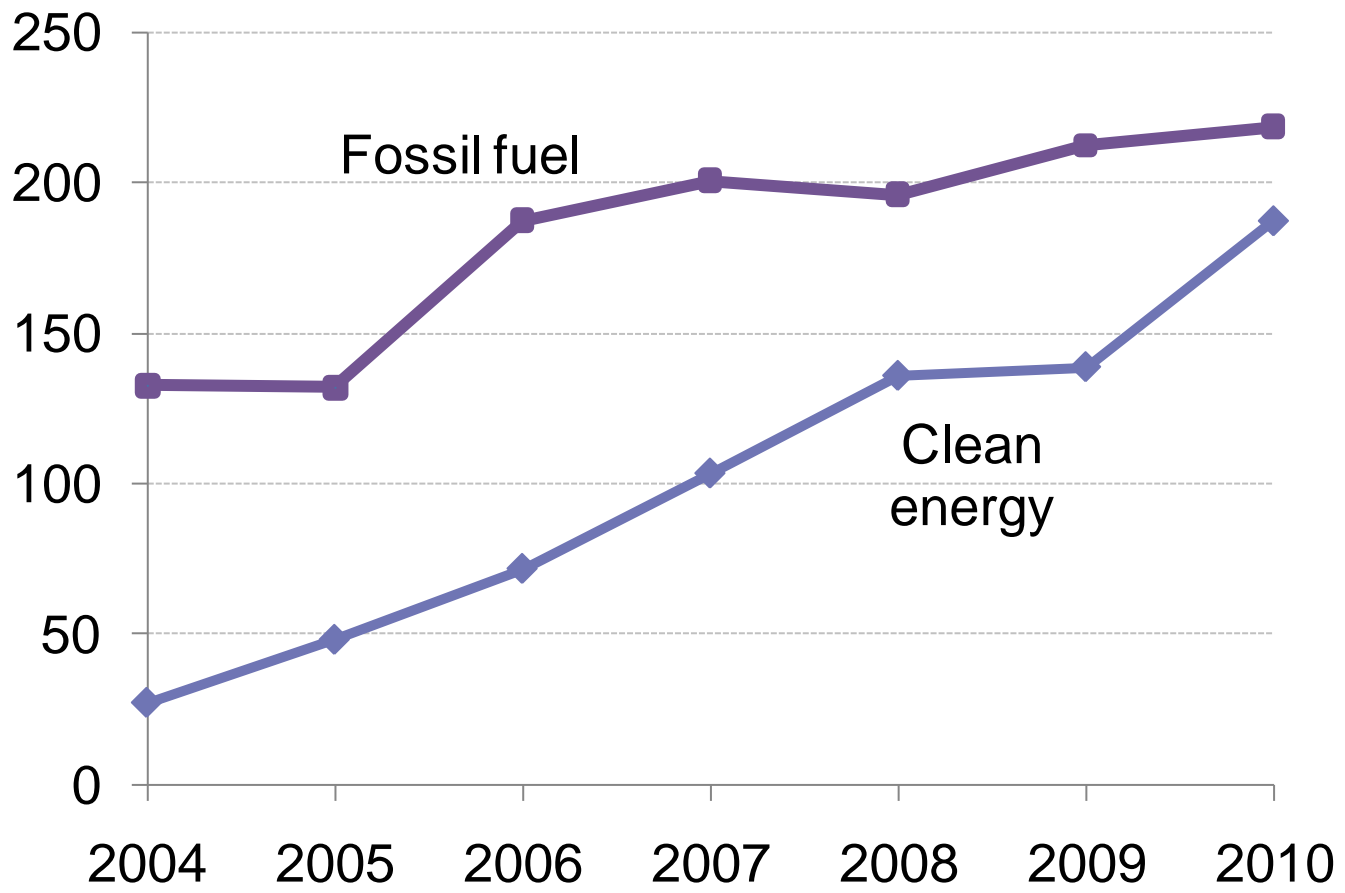


Note: Includes corporate and government R&D, and small distributed capacity. Adjusted for re-invested equity. Does not include proceeds from acquisition transactions

Source: Bloomberg New Energy Finance

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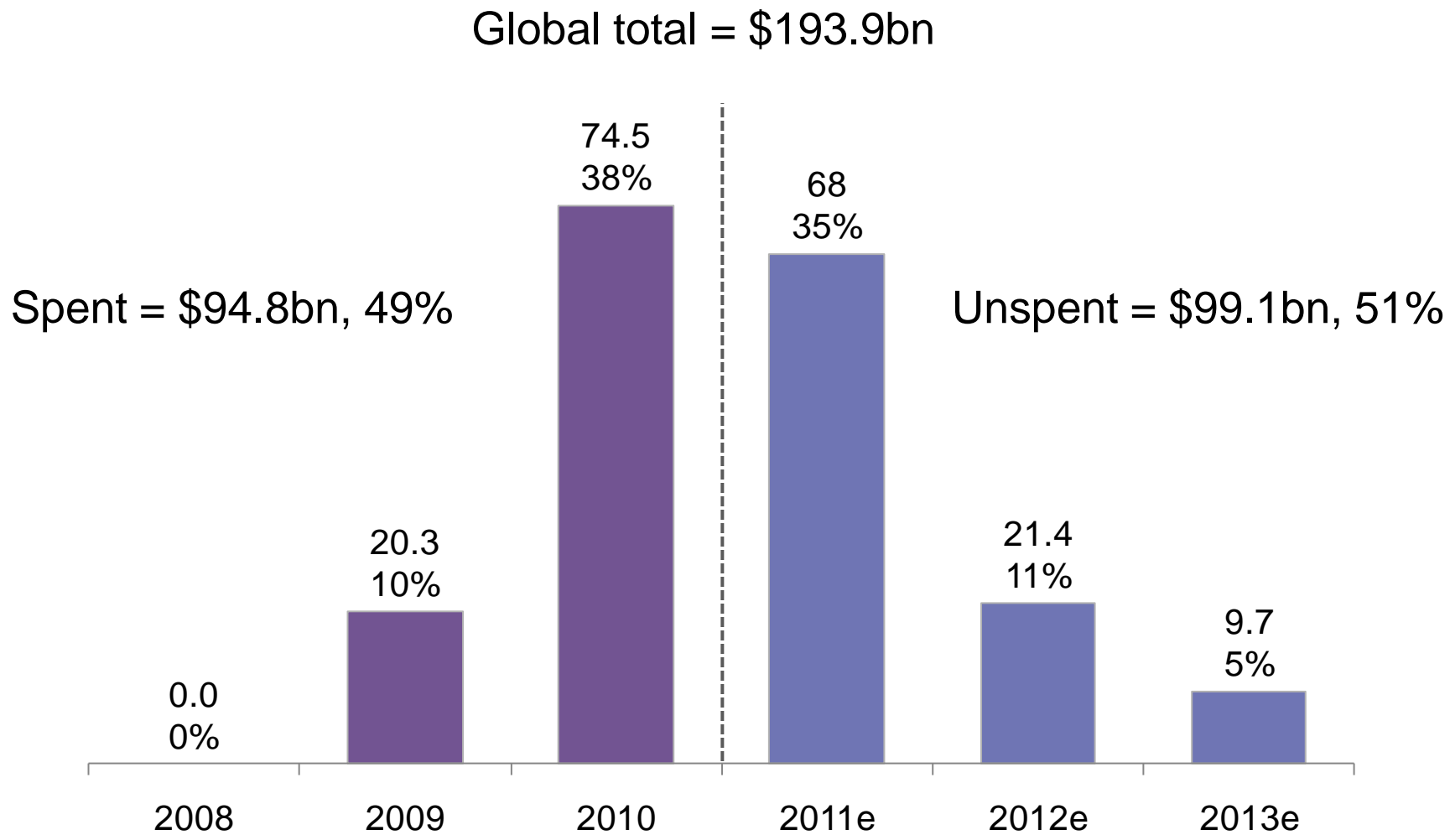
# CLEAN VS FOSSIL-BASED GENERATING CAPACITY INVESTMENT, 2004–10 (\$BN)



Note: Investment for new build – fossil fuel calculated from EIA & IEA numbers, clean energy taken from Bloomberg New Energy Finance totals. Clean energy capacity includes small distributed capacity.

Source: IEA, EIA, Bloomberg New Energy Finance

# GLOBAL CLEAN ENERGY STIMULUS SPENDING BY YEAR, 2011–13 (\$BN)

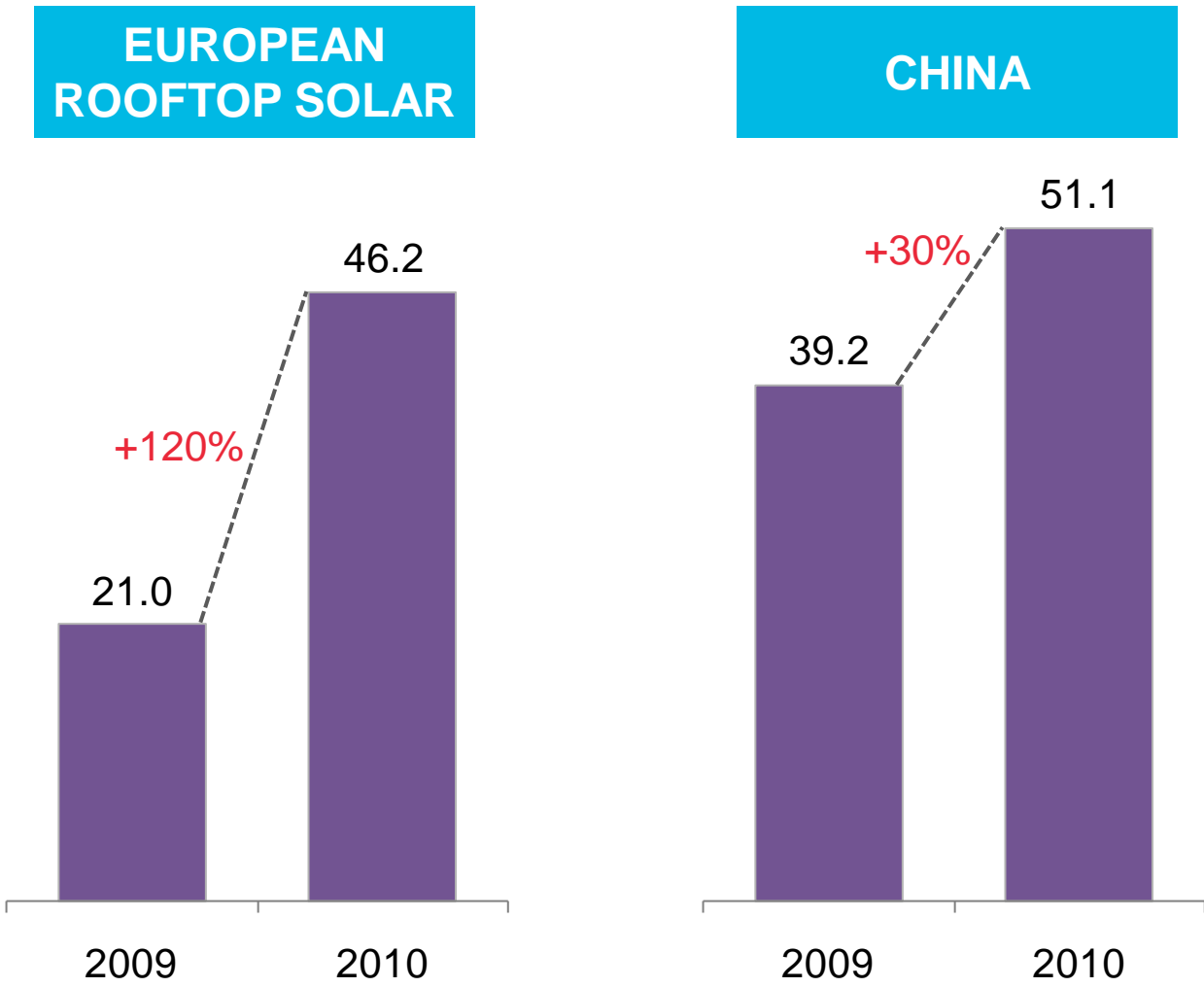


Note: 2011–13 according to Bloomberg New Energy Finance expectations

Source: Bloomberg New Energy Finance

# DRIVERS OF INVESTMENT GROWTH, 2009–10 (\$BN)

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Source: Bloomberg New Energy Finance

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# POLICY BALANCE SHEET, 2010–11

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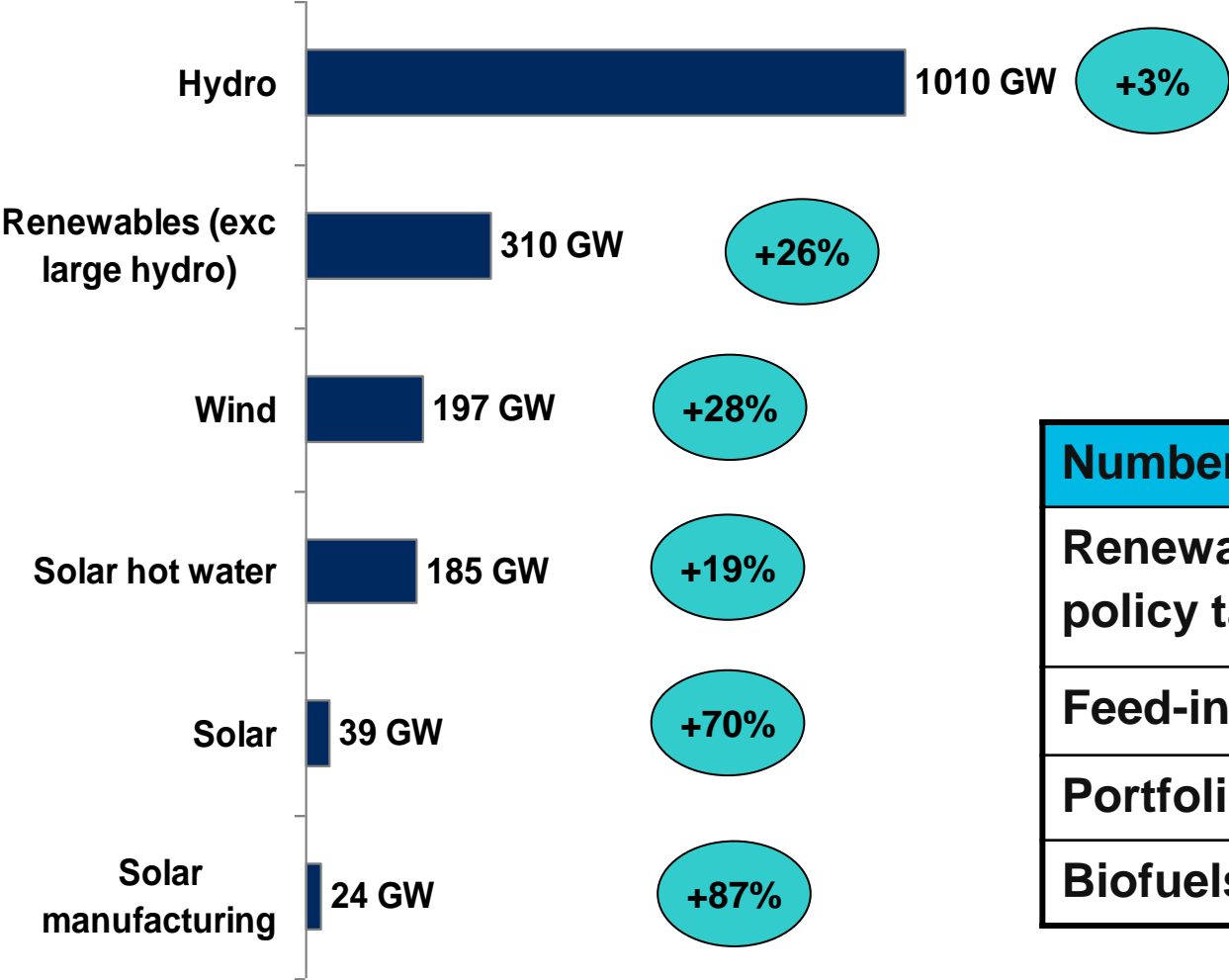
## NEGATIVES

- Regulatory pushback over smart grid programs in US
- No US climate or energy bill
- US midterms
- Retrospective changes to tariff regimes in Czech Republic & Spain
- Tariff reductions in other EU countries

## POSITIVES

- Brazilian wind tenders
- Italy tariffs remain in place
- Unexpected success of Cancun
- Indian Solar Mission programme
- CA victory over Proposition 23
- EU funding progress on CCS
- UK confirms Climate Bill / Green Bank

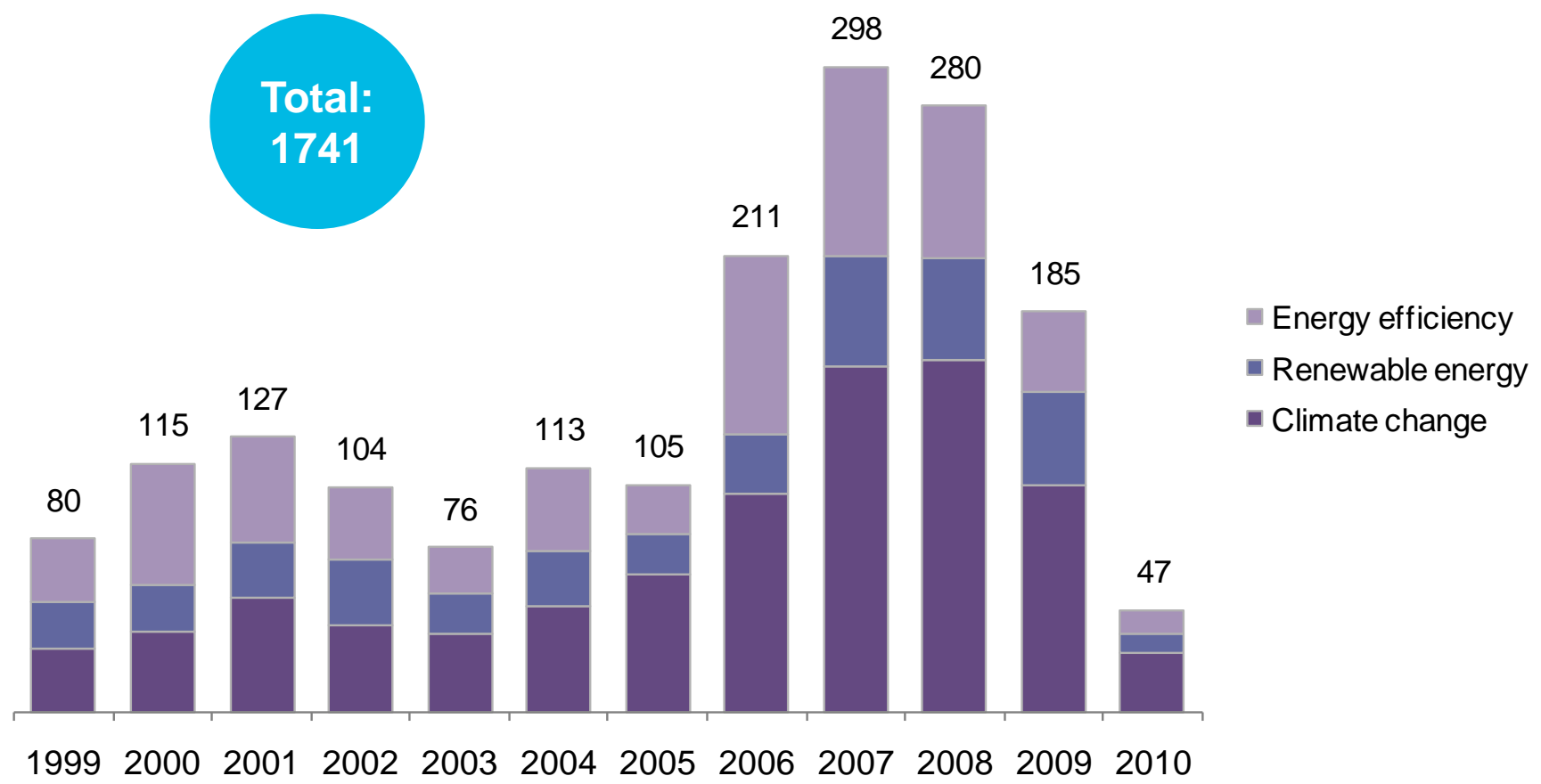
# Global Renewable Energy Indicators



Numbers of Countries (2010)	
Renewable energy policy targets	89
Feed-in tariffs	81
Portfolio standards	52
Biofuels mandates	73

Source: REN21, Bloomberg New Energy Finance

# GLOBAL ENERGY & EMISSION-RELATED POLICIES, 1999–10



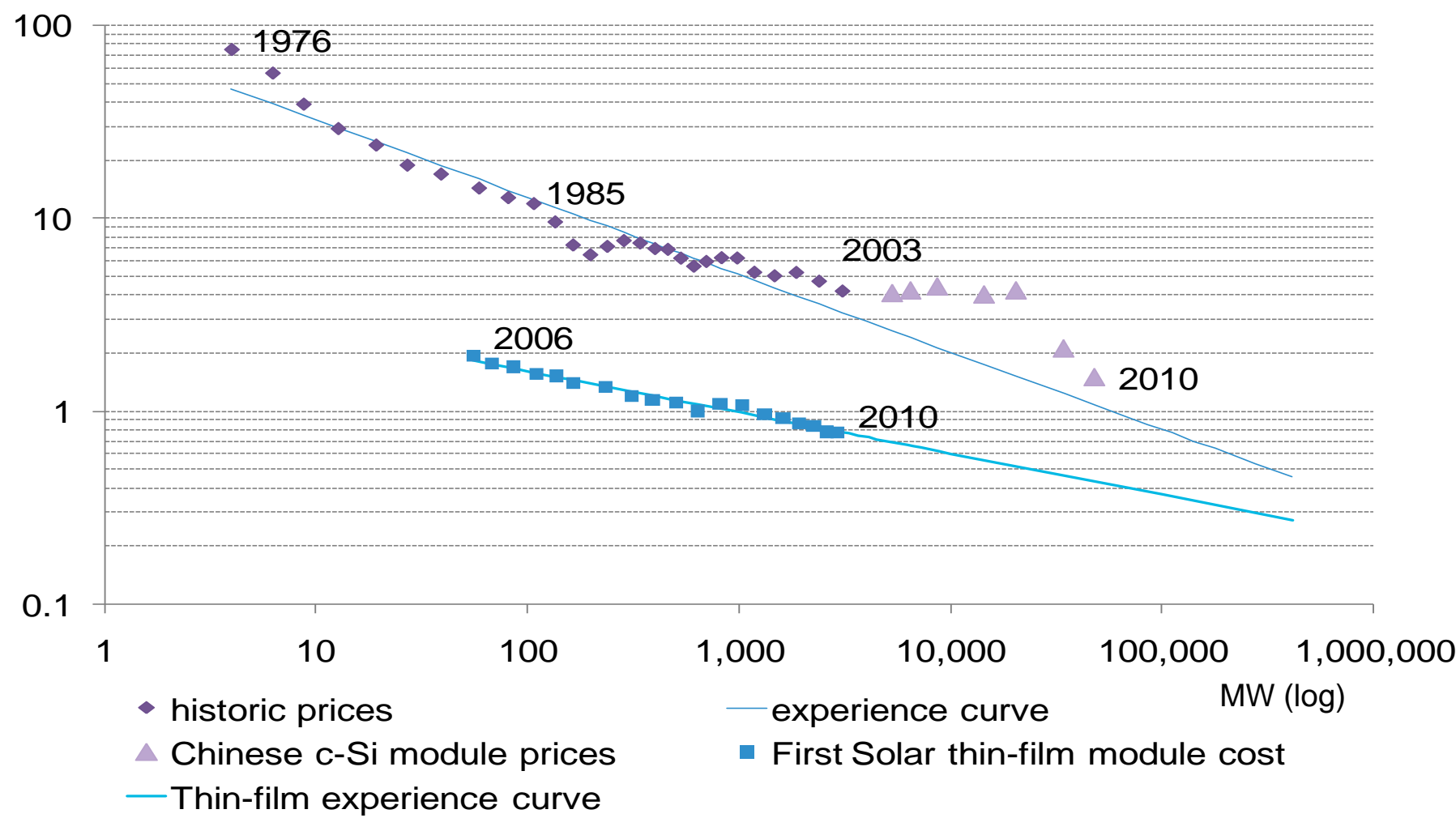
Source: Bloomberg New Energy Finance

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# THE PV MODULE EXPERIENCE CURVE, 1976–2010 (\$/W)

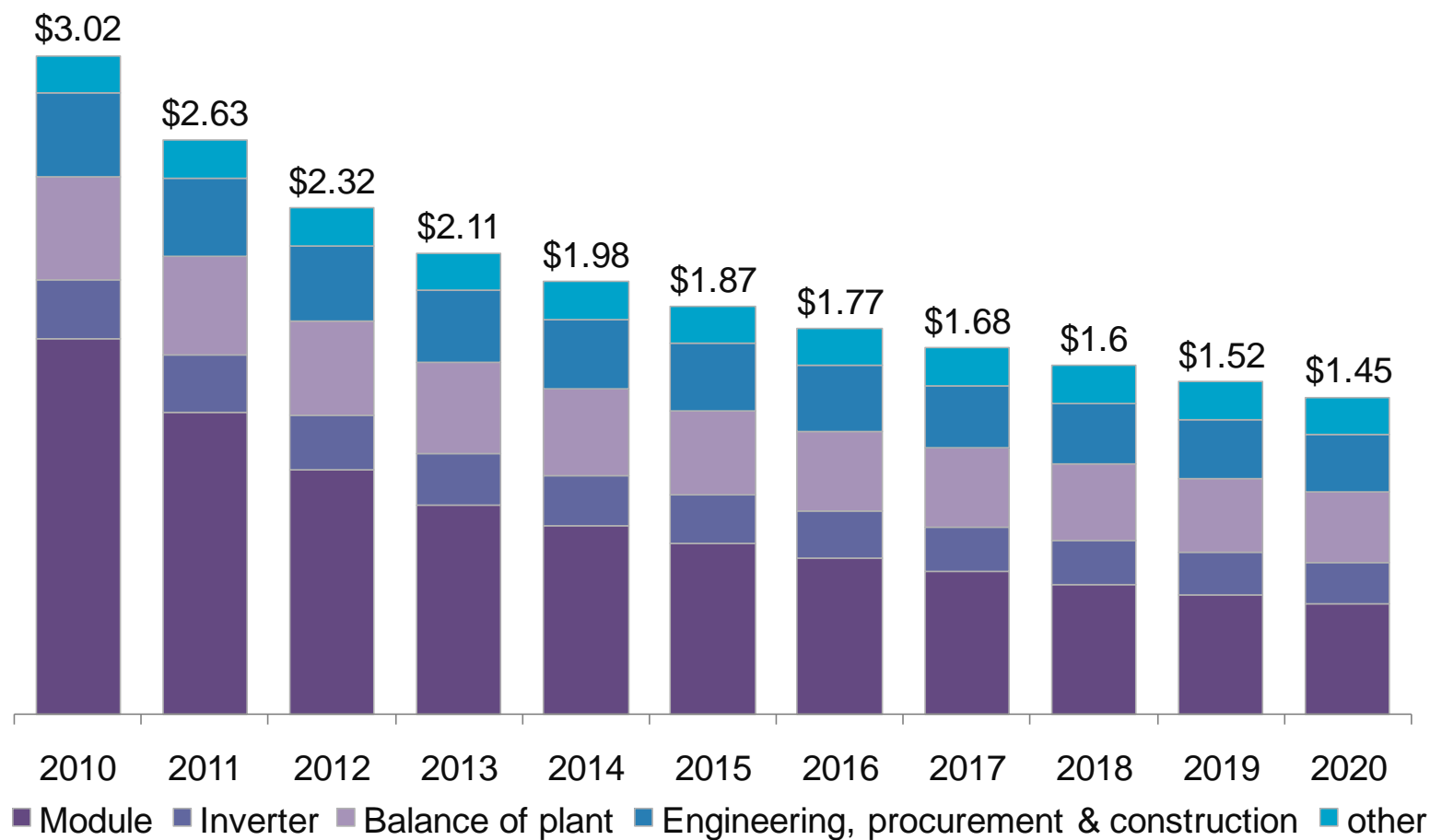


Notes: Inflation adjustment using US PPI, R2 of c-Si regression = 0.94, R2 of FSLR regression = 0.98

Source: Bloomberg New Energy Finance, FSLR filings

# FORECAST LARGE PV PROJECT CAPITAL COST

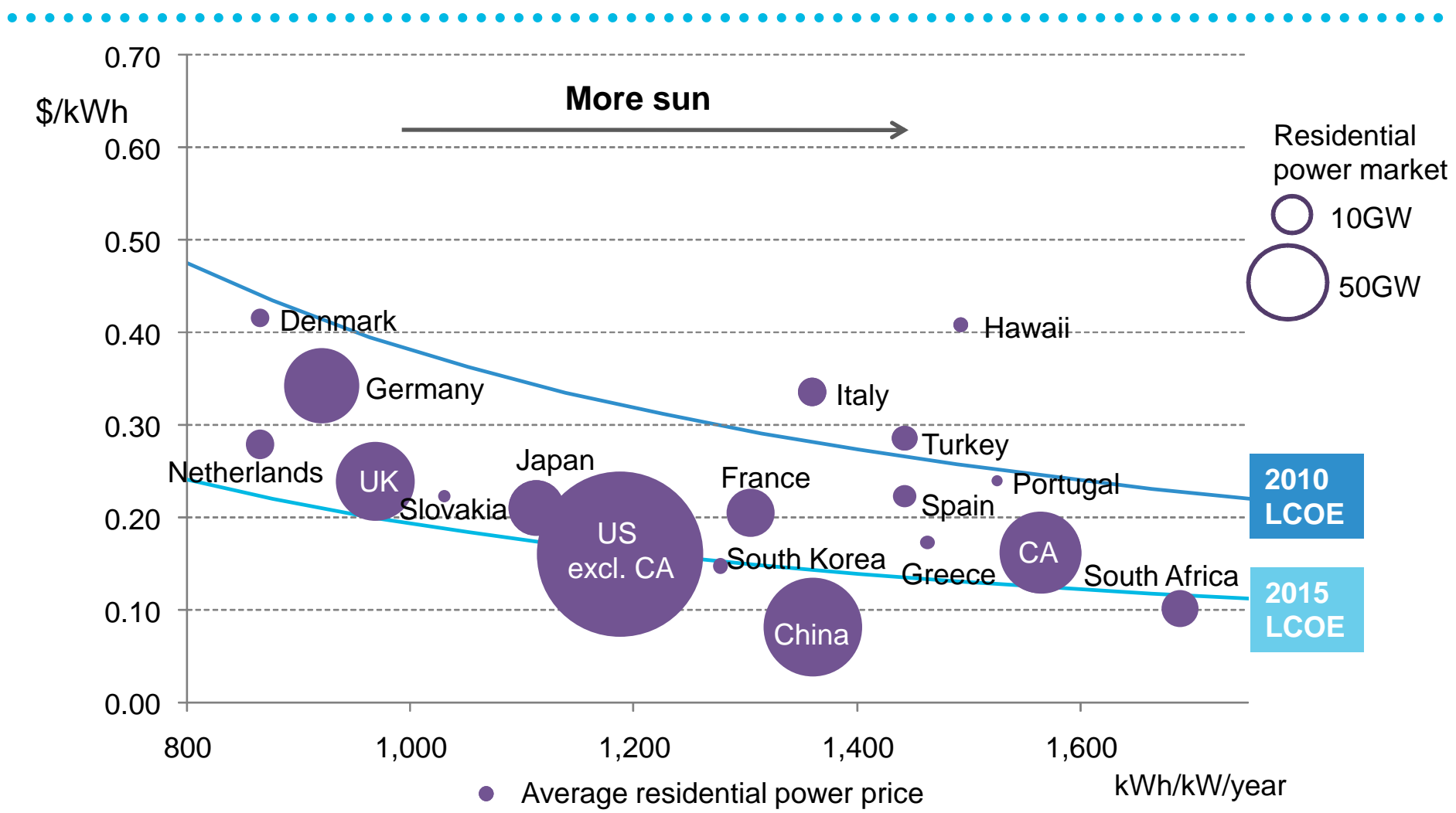
## 2010 – 2020 (\$/W)



Note: Based on historical experience curves for crystalline silicon modules and other components, and the prices in the mature German market. 2010 dollars. Assumes Bloomberg New Energy Finance short-term build forecasts to 2013, 20% new build growth after that.

Source: Bloomberg New Energy Finance

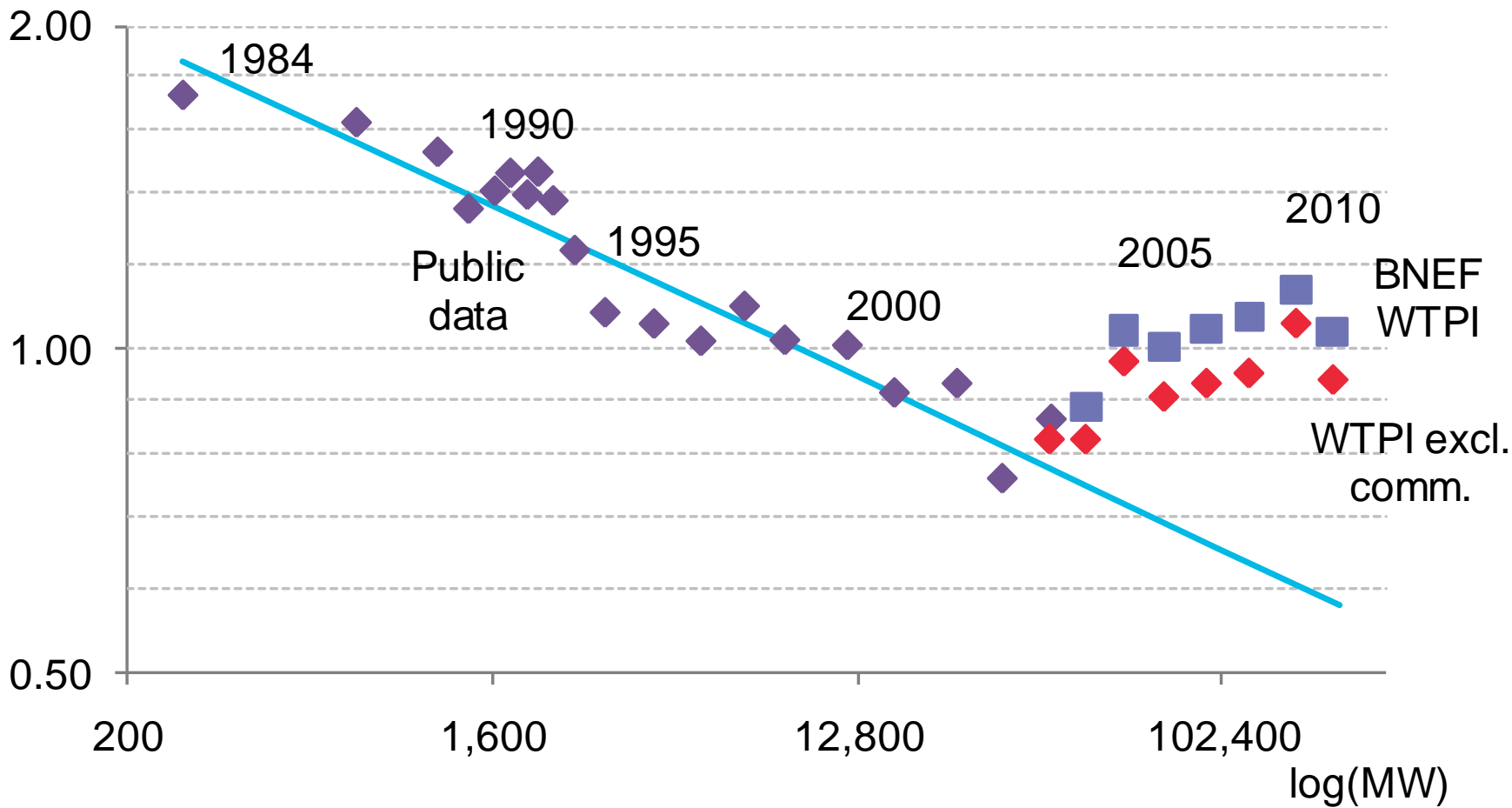
# RESIDENTIAL PV PRICE PARITY



Note: LCOE based on 6% weighted average cost of capital, 0.7%/year module degradation, 1% capex as O&M annually. CA is California.

Source: Bloomberg New Energy Finance

# WIND TURBINE PRICE INDEX, 1984–2010 (EUR M/MW)

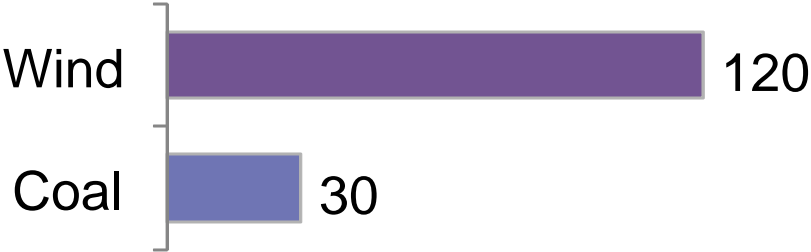




# LEVELIZED COSTS: BEST NEW WIND VS NEW COAL (\$/MWh)

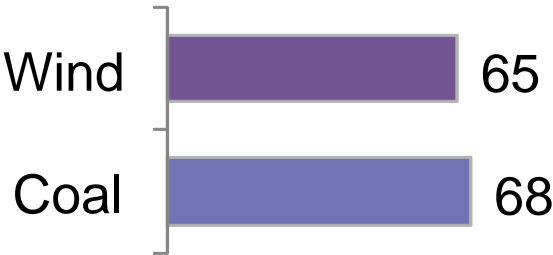
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Perception:



- New coal must cover cost of capital
- New coal requires advanced pollution control
- Wind turbines back to 2005 prices, but now perform much better

Reality:

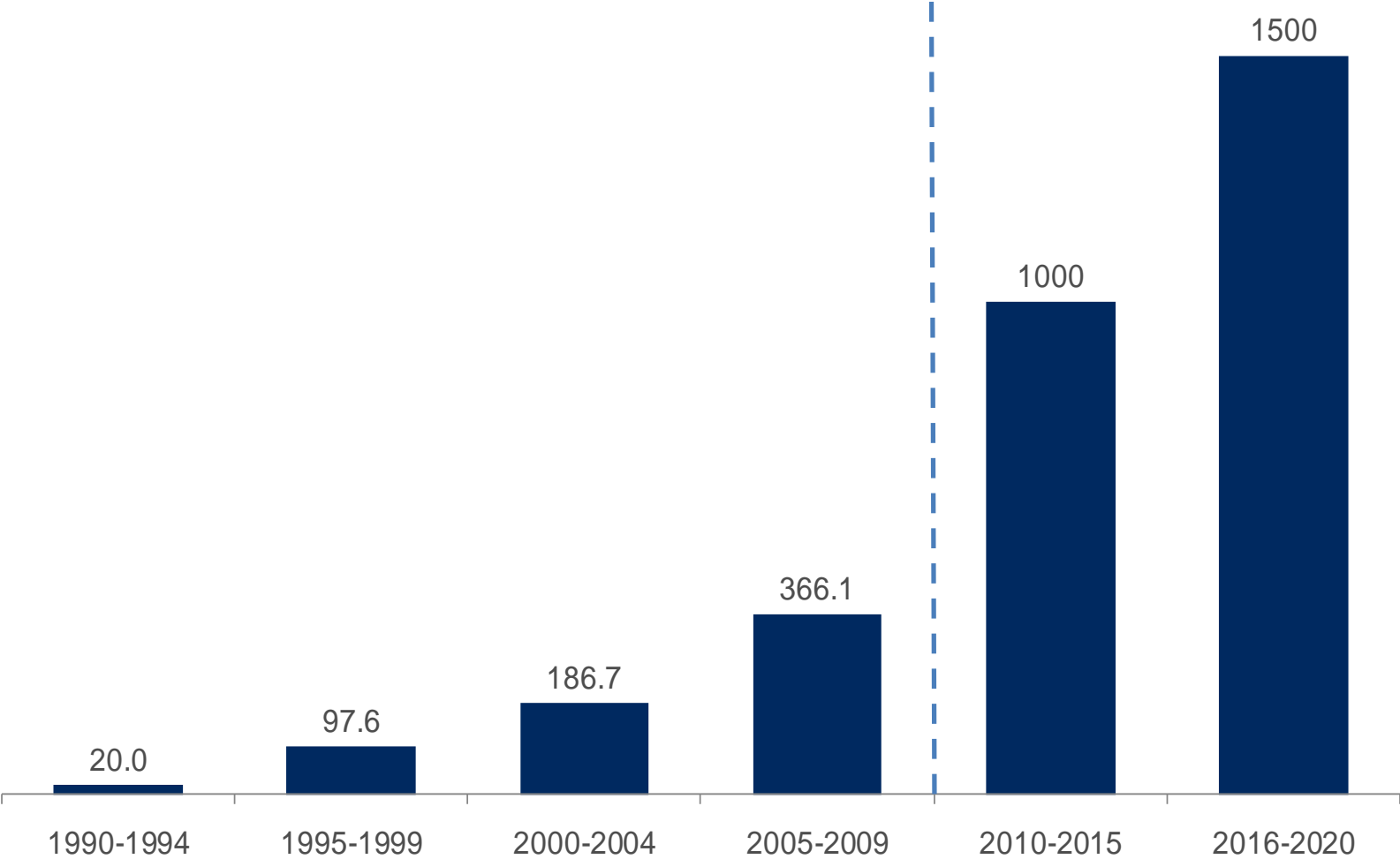


- Wind bankability has driven down cost of capital
- Coal suffers from carbon price risk

Source: Bloomberg New Energy Finance

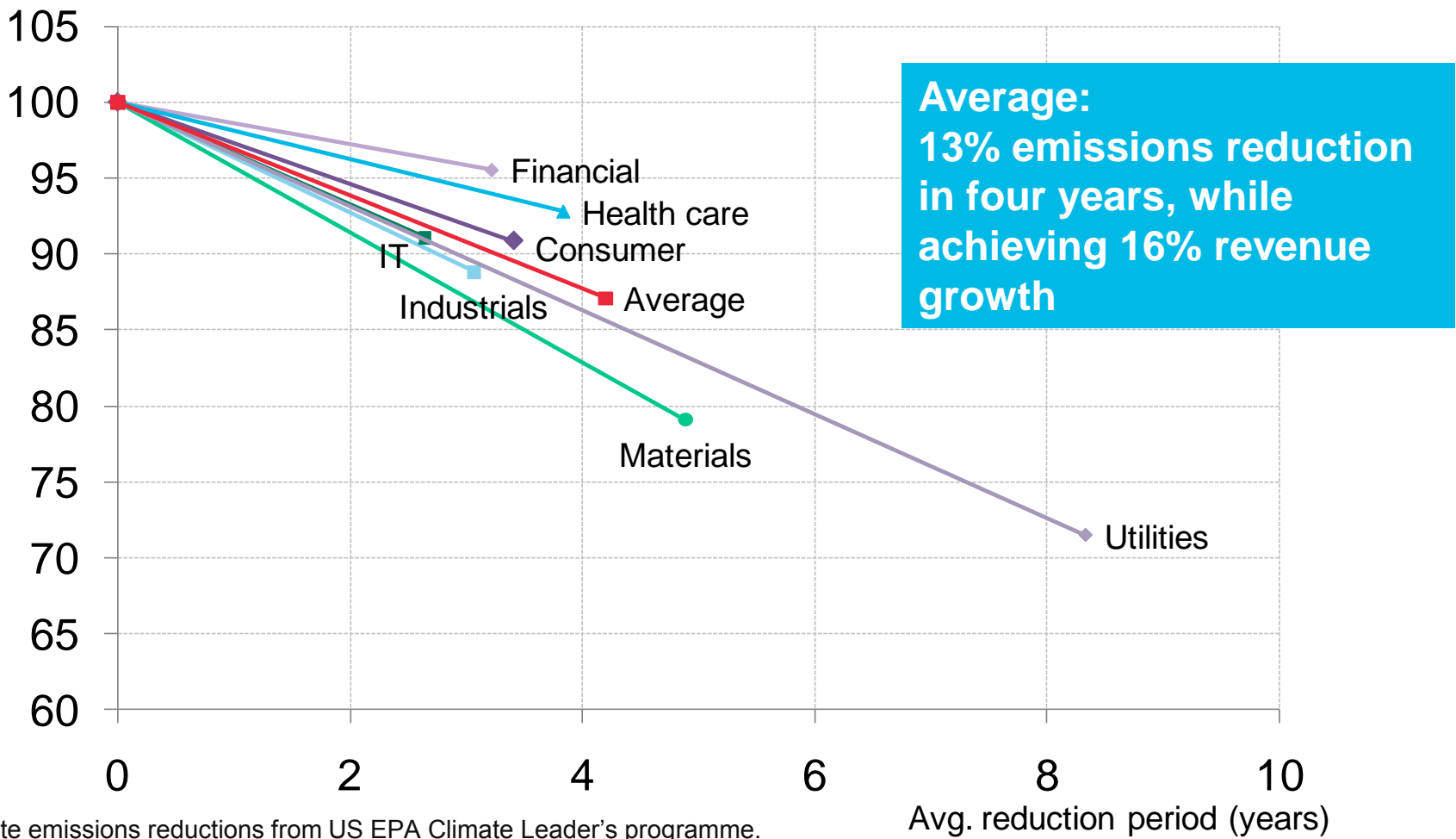
# Maximum size of commissioned wind farms: 1990 – 2020 (MW)

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Source: Bloomberg New Energy Finance

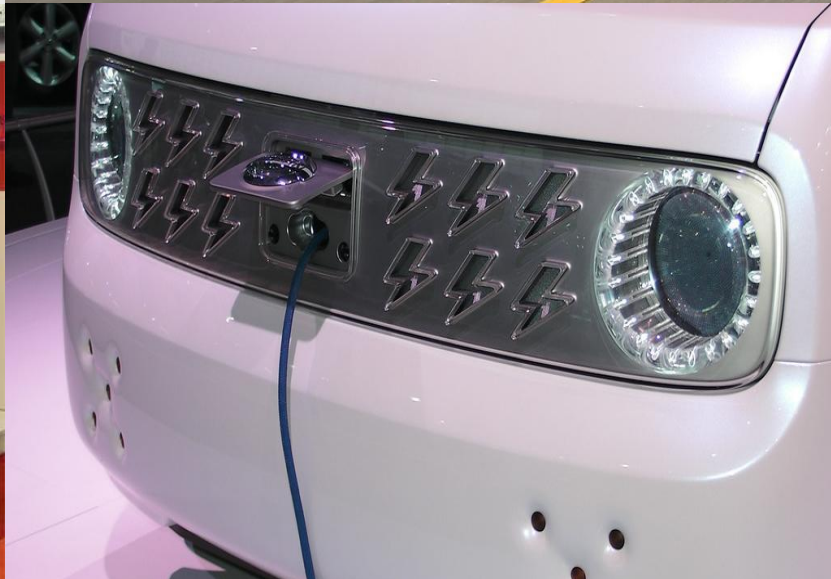
# EPA CLIMATE LEADERS CO2 REDUCTIONS BY SECTOR (%)



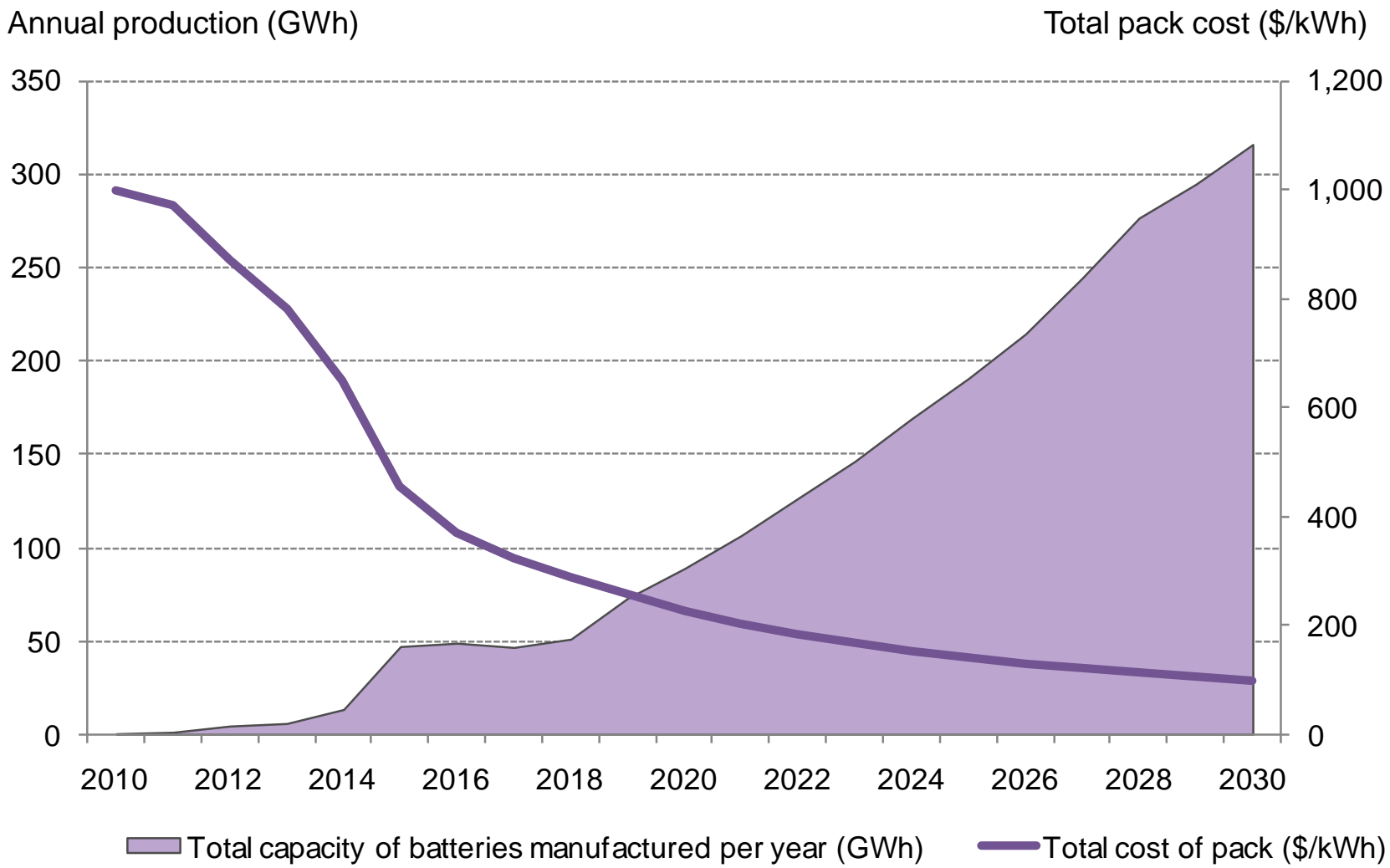
Note: Absolute emissions reductions from US EPA Climate Leader's programme. Company submissions were aggregated by sector and average percentage reduction plotted (above). 88 companies included. Revenue data for 53 of these companies in 2005–09 period. 'Consumer' short for 'consumer products'

Source: EPA, Bloomberg New Energy Finance

# MAINSTREAMING OF ELECTRIC VEHICLES



# LITHIUM-ION BATTERY PACK COST, TRACTION BATTERY PRODUCTION, 2010–30

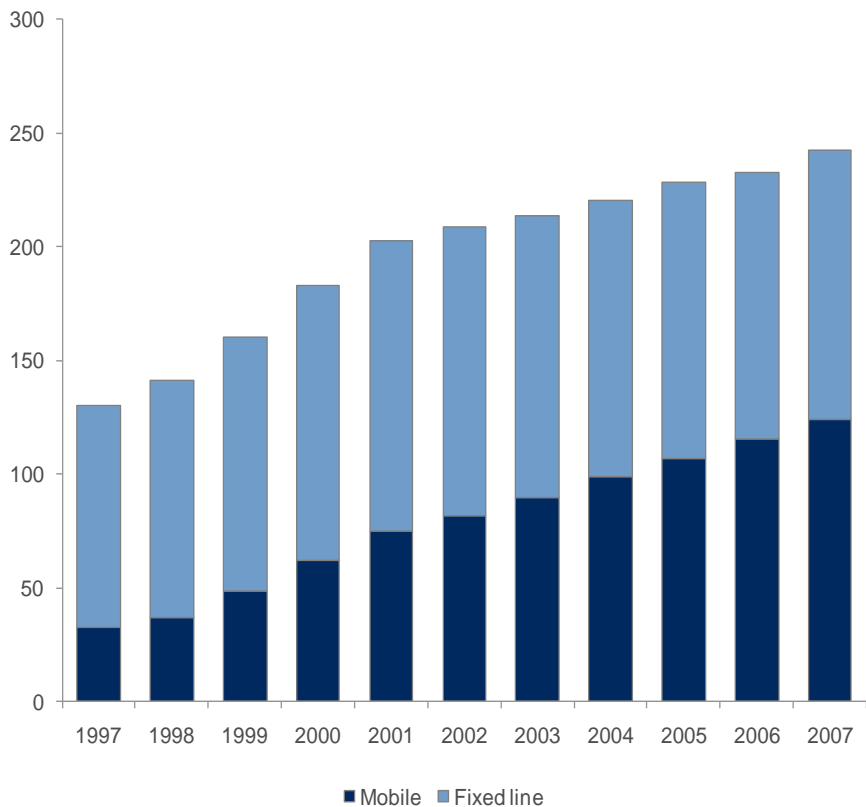


Note: Total pack cost includes the battery management system

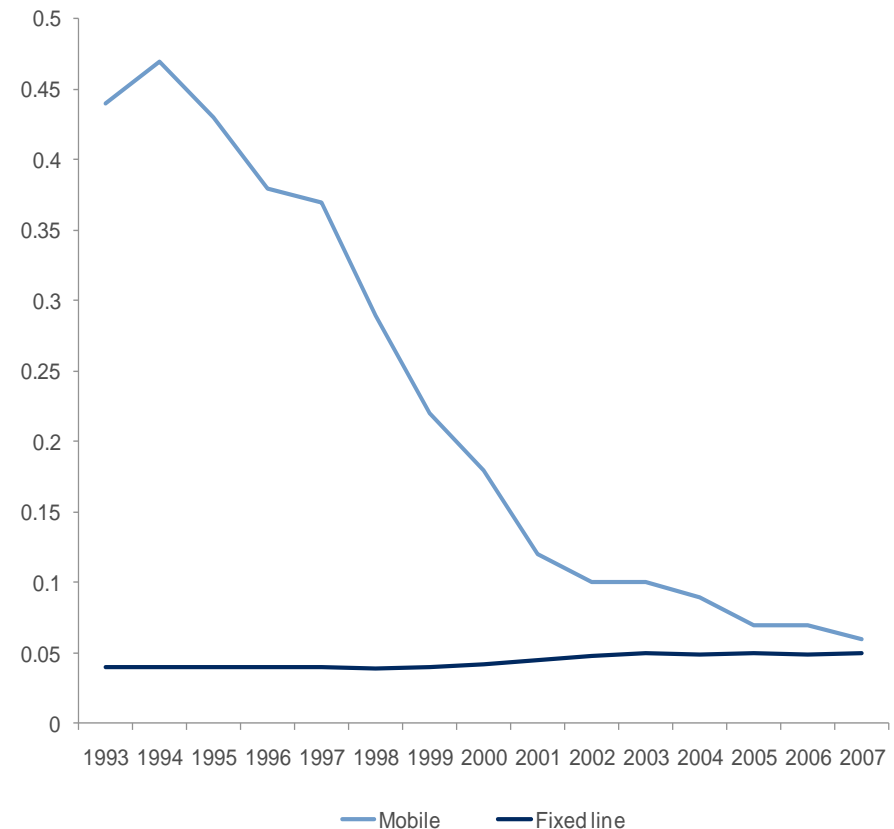
Source: Bloomberg New Energy Finance

# Case study: mobile telephony

US telecoms revenue split (\$bn)



US fixed line vs mobile prices (\$/min)



Source: Federal Communications Commission; Bloomberg New Energy Finance

Source: Federal Communications Commission; Bloomberg New Energy Finance

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# DEEPWATER HORIZON

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# NORTH AFRICA & THE GULF

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Source: AFP

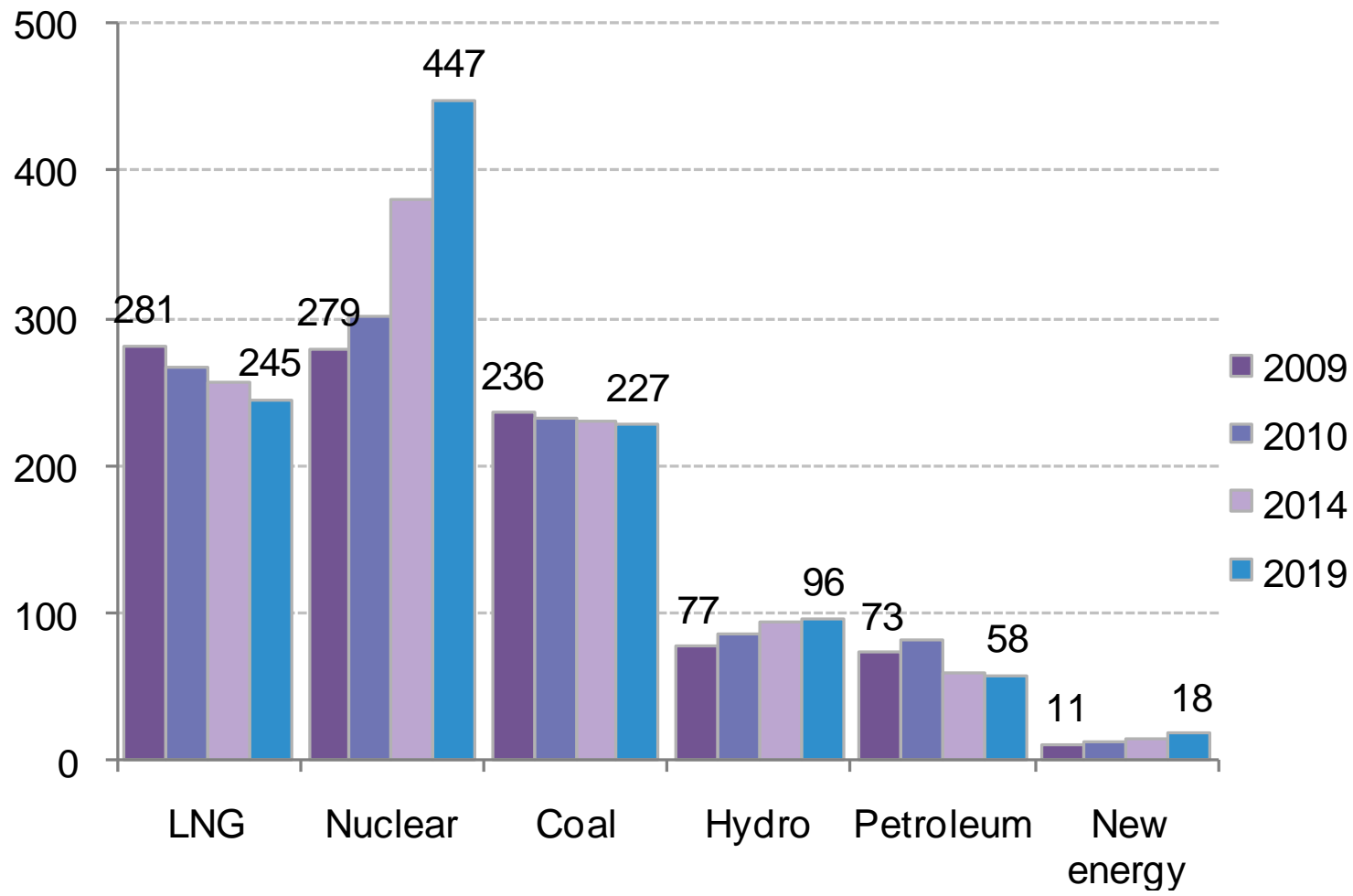
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# FUKUSHIMA DAIICHI

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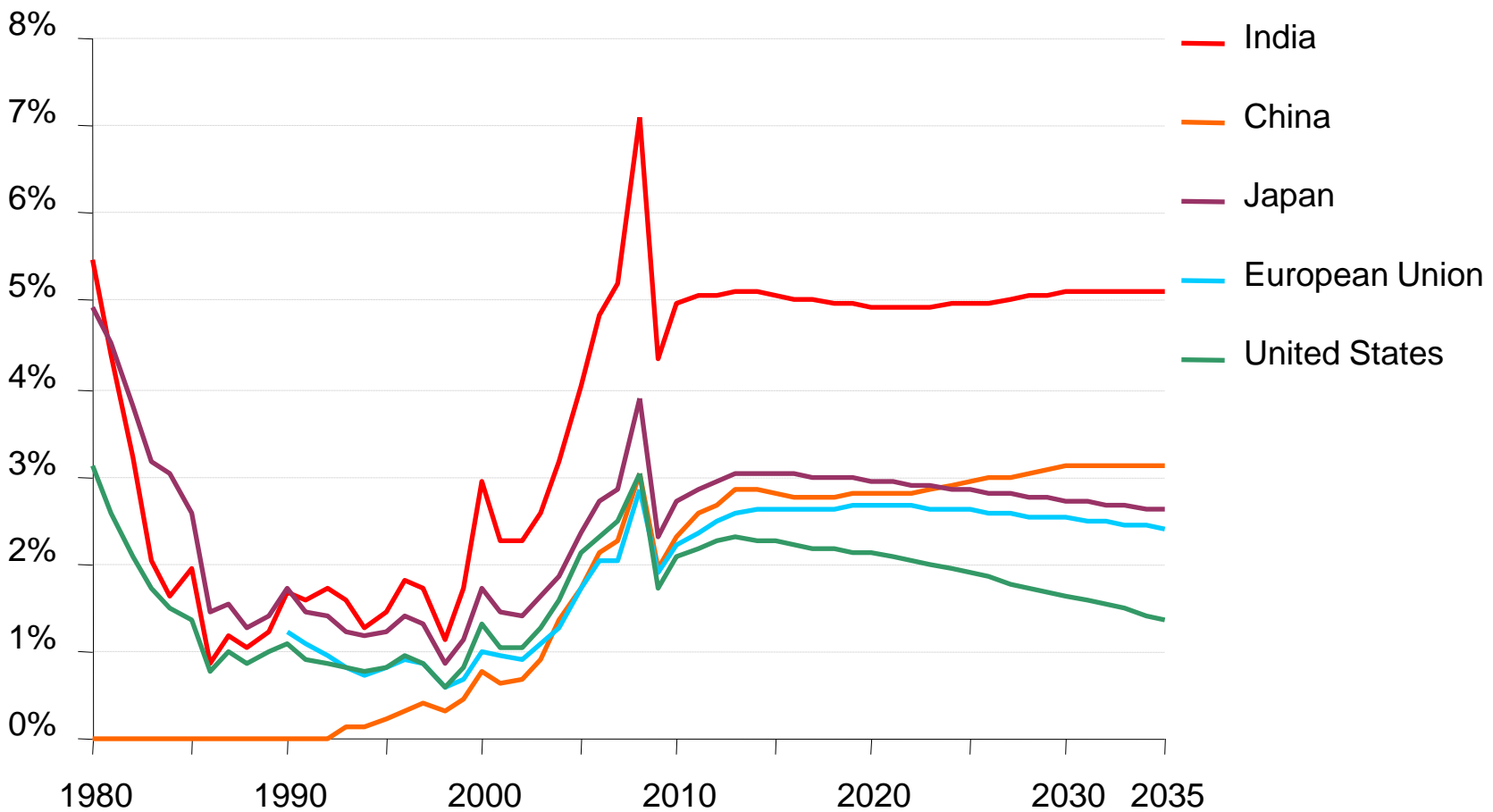
# PRE-EARTHQUAKE PLANNED TOTAL ELECTRICITY SUPPLY BY SOURCE, JAPAN, 2009–19 (TWh)



Source: Ministry of Economy, Trade and Industry, Electricity Supply Plan of 2010, 31 March 2010

# SPENDING ON NET IMPORTS OF OIL & GAS

## (% OF GDP, IEA WEO 2010 CENTRAL SCENARIO)

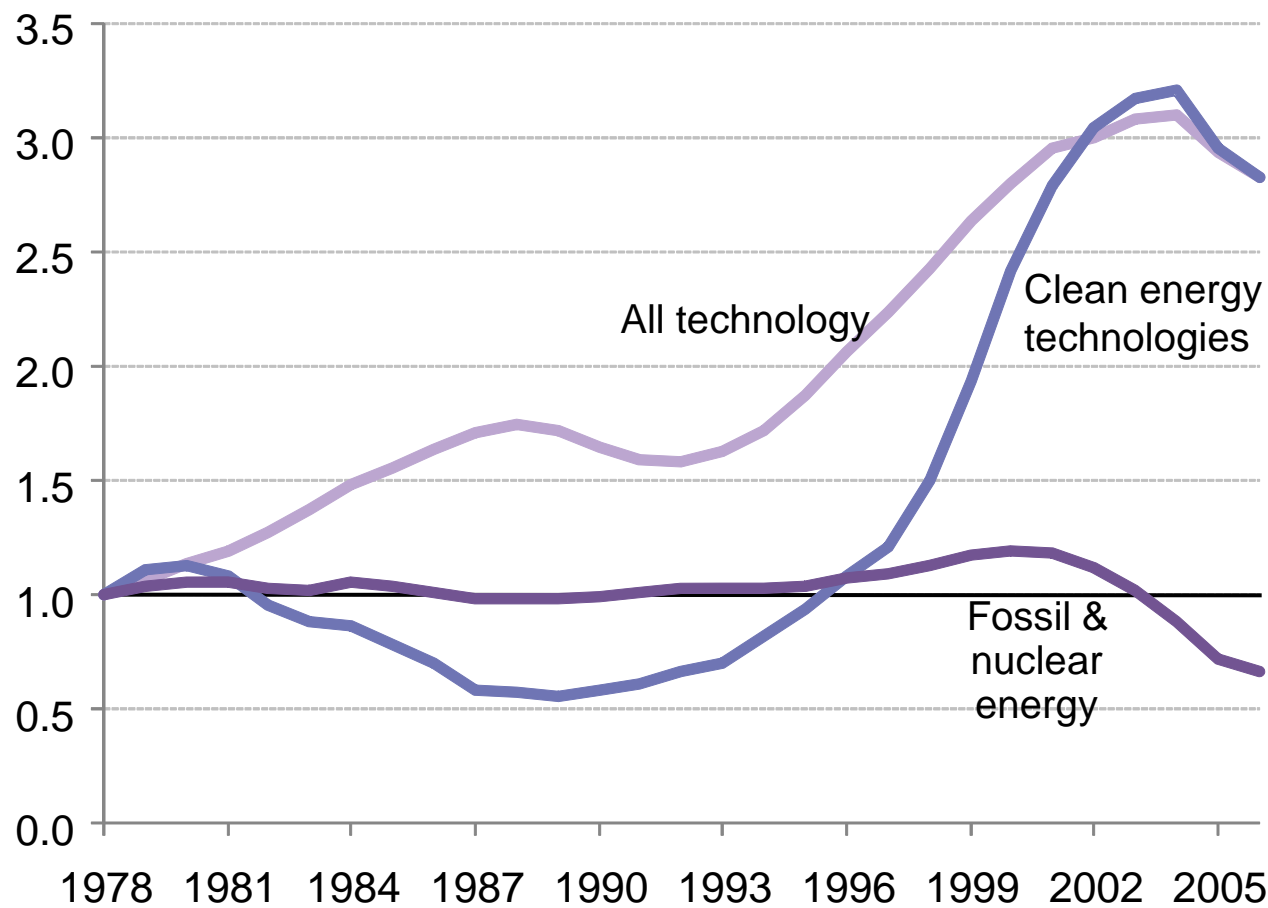


Note: Based on oil price rising to \$120 (\$2009) by 2030

Source: IEA WEO 2010

# INTERNATIONAL PATENTS WORLDWIDE, 1978–2006

## (NUMBER OF PATENTS, INDEXED)



Note: Three-year moving average, normalised to 1.0 in 1978

Source: UNEP-EPO-ICTSD Report, Bloomberg New Energy Finance

# What we are seeing

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Fundamental re-engineering of the world's energy industry around low carbon solutions and architecture:

- Will cost trillions and take decades
- Will be heavily policy-driven (incentives and disincentives)
- Is inevitable, given economics
- Will be funded by capital markets
- Will be risky to bet against

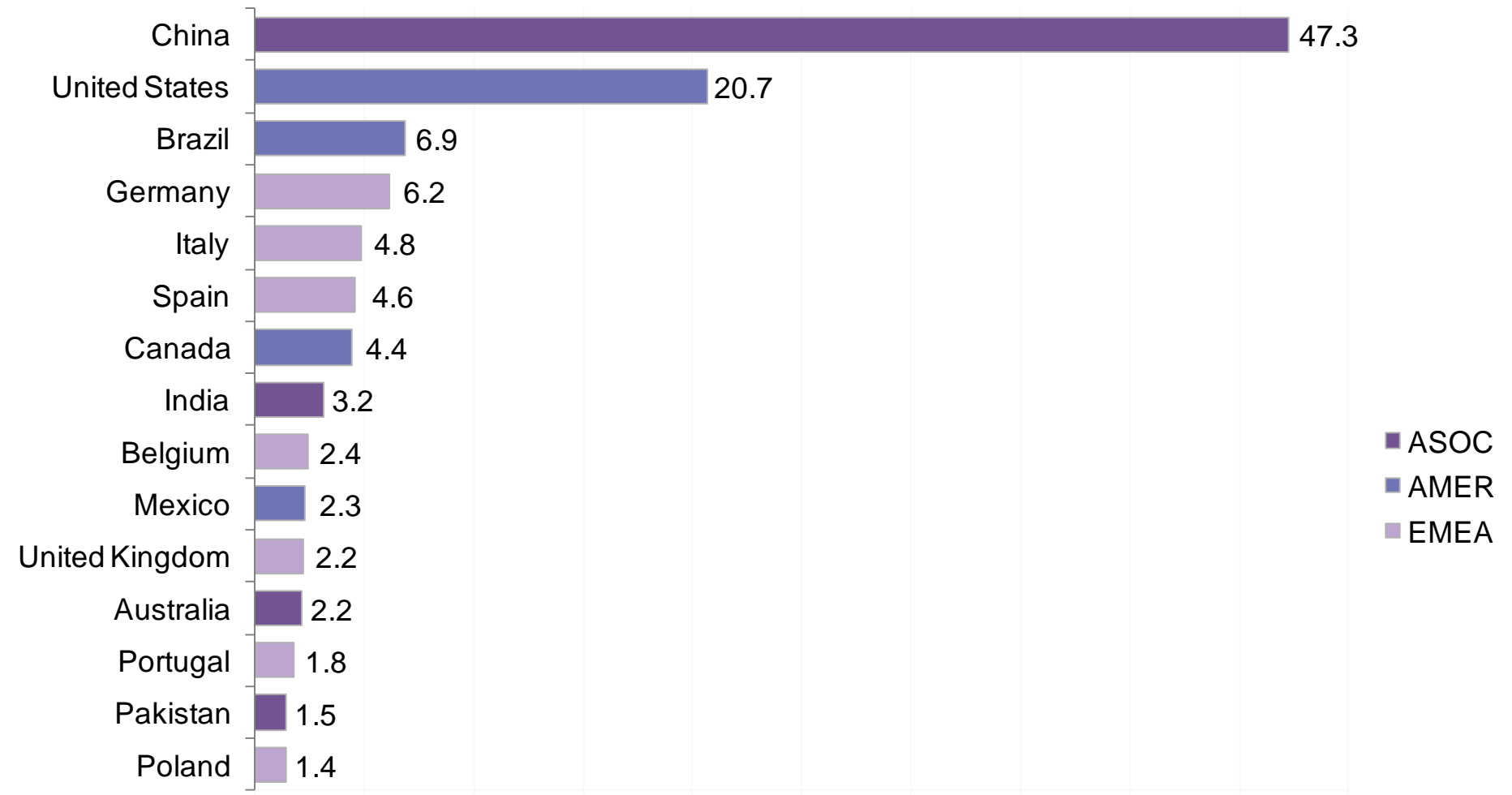
Source: New Energy Finance

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# ASSET FINANCE FOR NEW BUILD CLEAN ENERGY – TOP 15 COUNTRIES, 2010 (\$BN)



Note: Total values include estimates for undisclosed deals

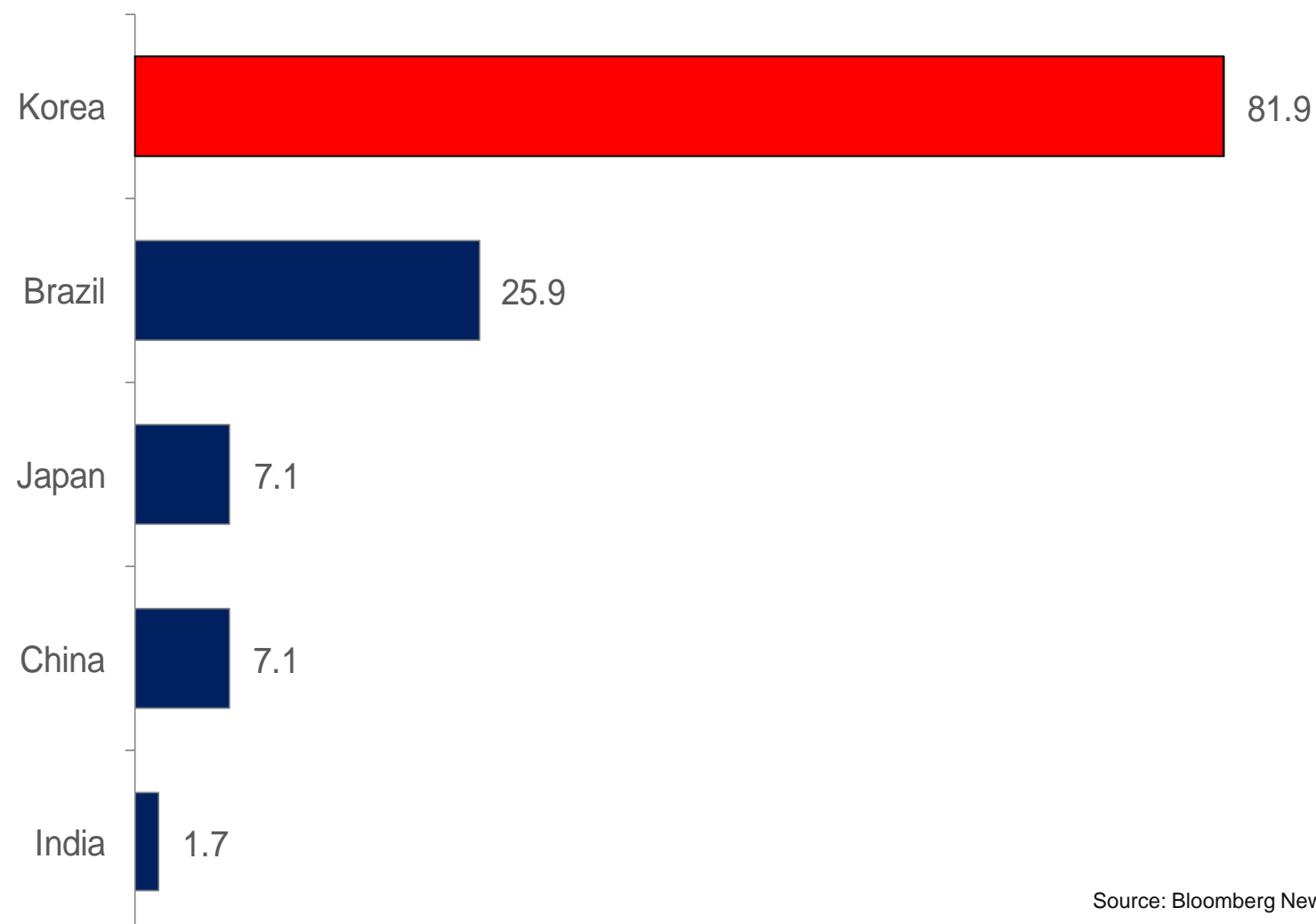
Source: Bloomberg New Energy Finance



# Industrial clean energy investment announcements

## As at 2010 (\$bn)

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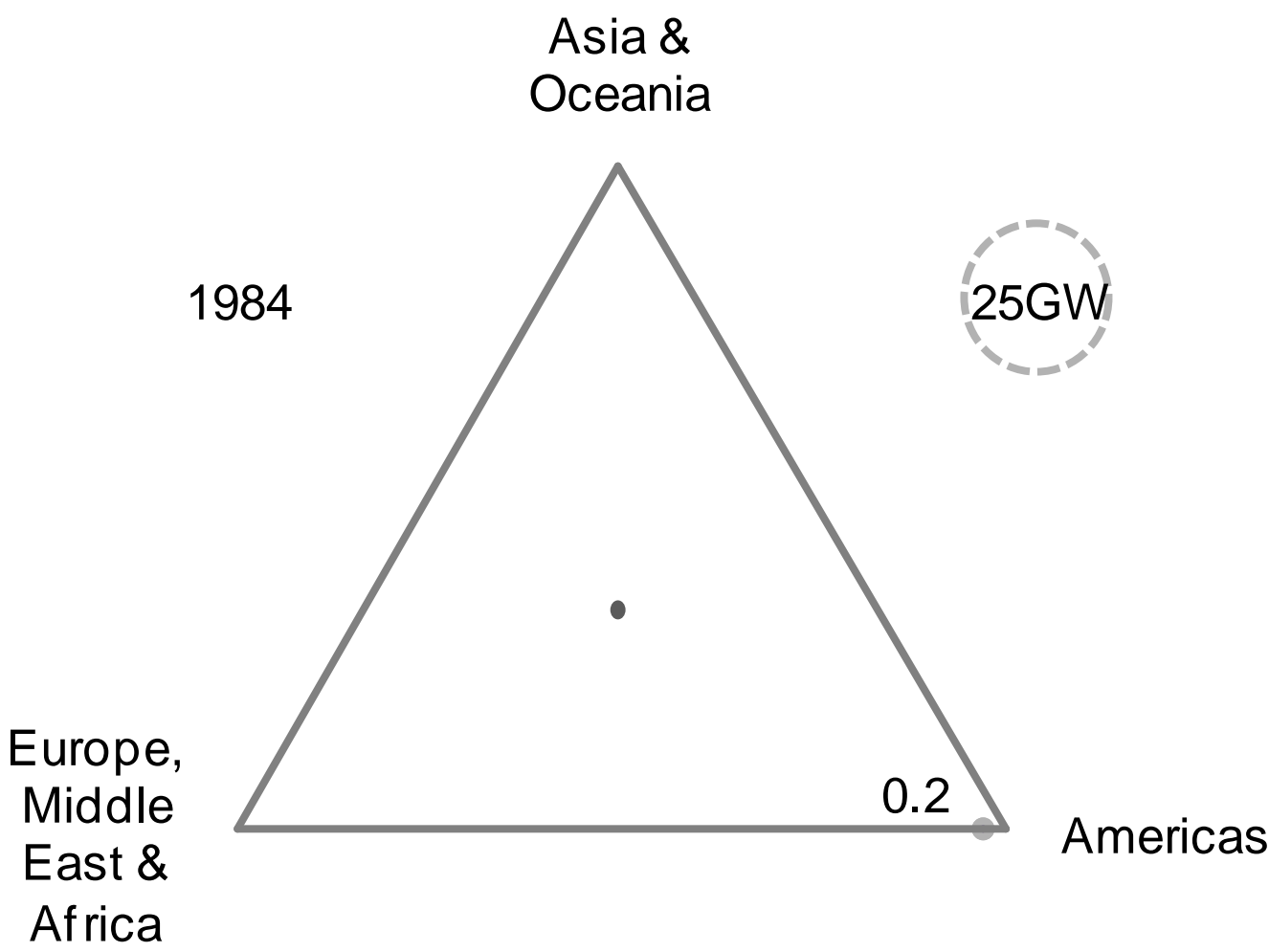


Source: Bloomberg New Energy Finance

Note: includes industrial clean energy corporate announcements as at September 2010 across renewable energy and energy efficiency up until the year 2020

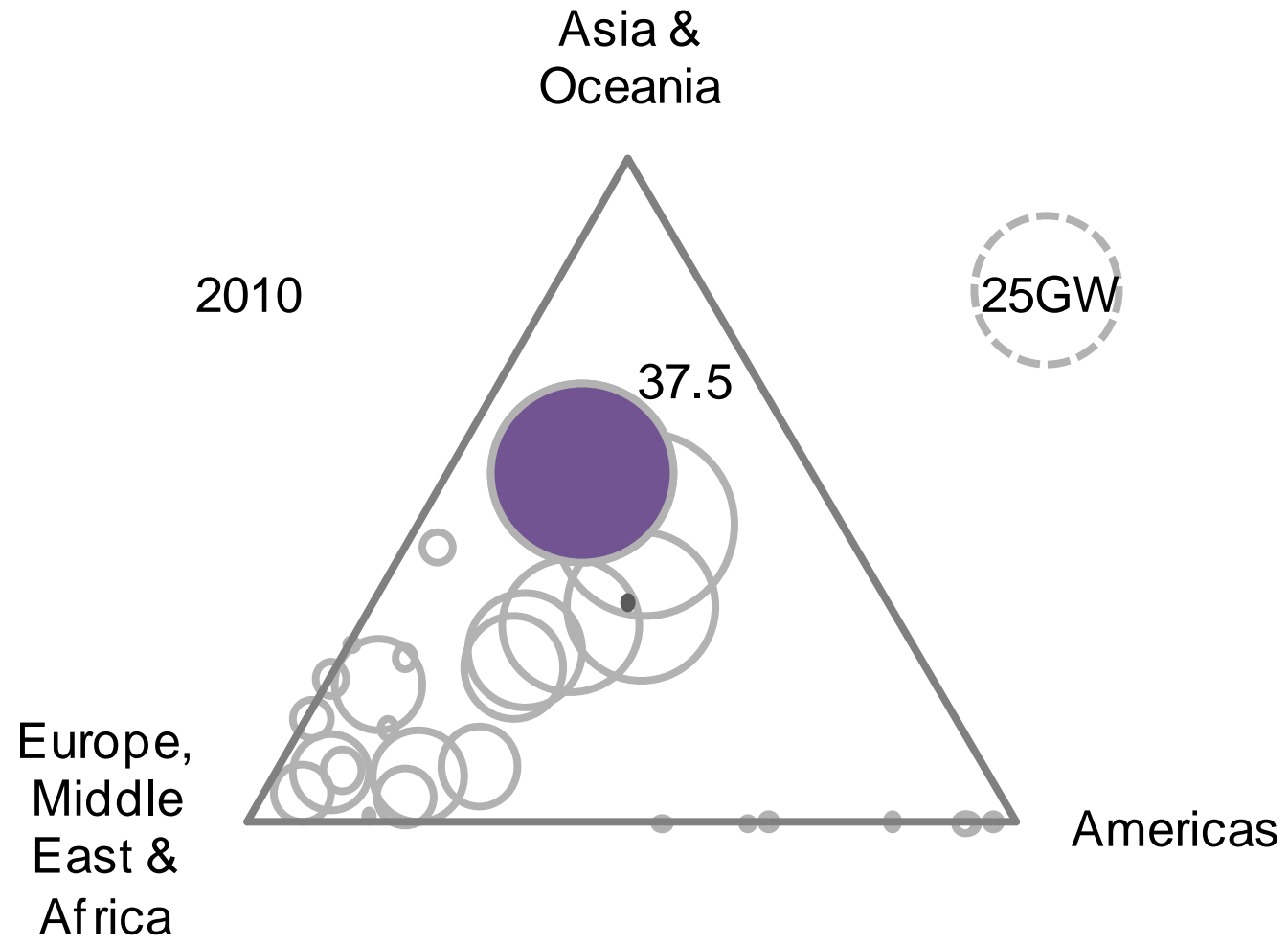
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# WIND-GENERATING CAPACITY NET ADDITIONS (GW)



Source: Bloomberg New Energy Finance

# WIND-GENERATING CAPACITY NET ADDITIONS (GW)



Source: Bloomberg New Energy Finance

# TOP 10 GLOBAL WIND MANUFACTURERS 2005, 2010 (RANK ORDER BY PRODUCTION)

**2005**

**+25% per year**

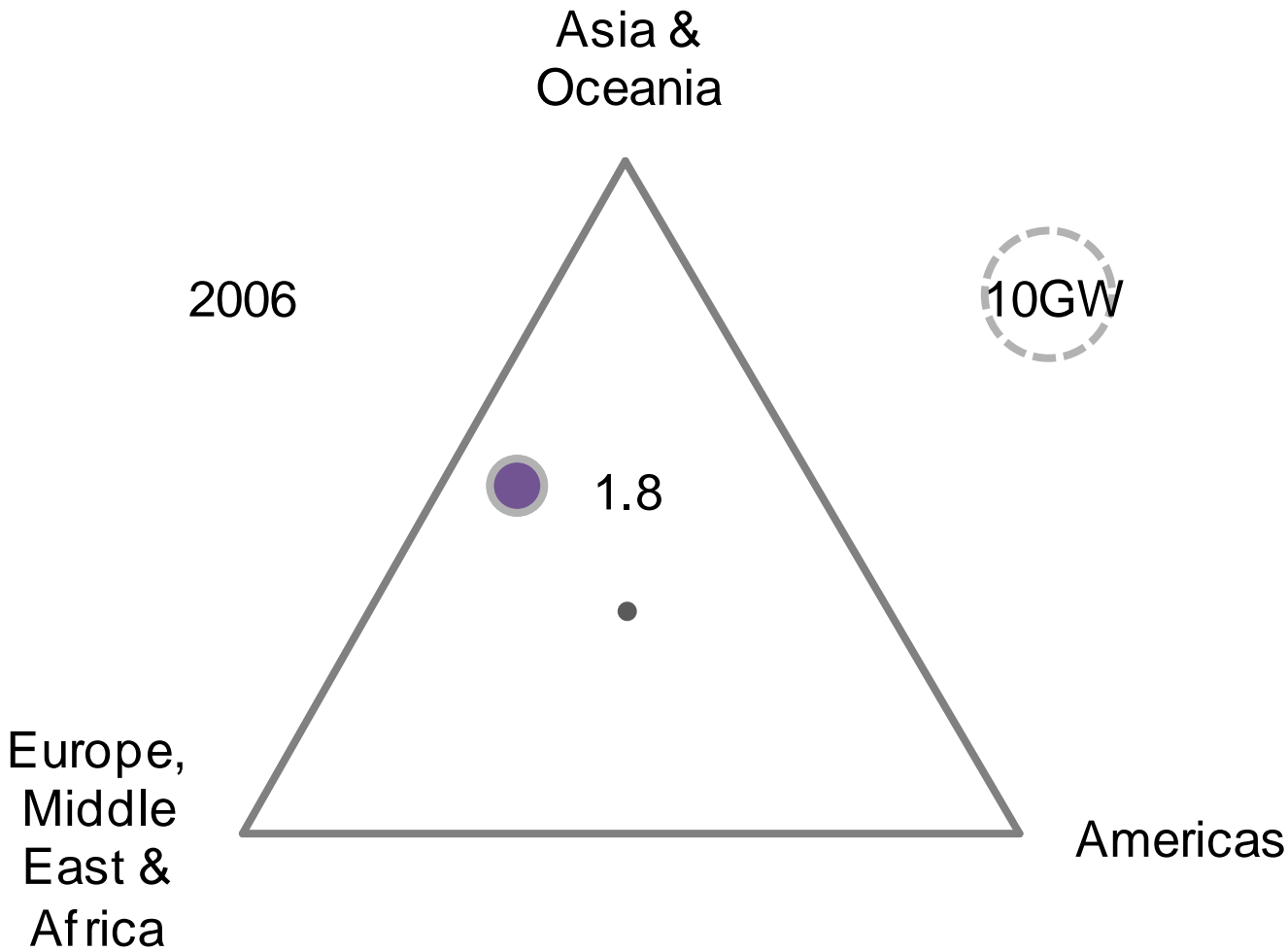
**2010**

Company	Country	Production (GW)	Company	Country	Production (GW)
1. Vestas	Denmark	3.2	1. Vestas	Denmark	6.3
2. Enercon	Germany	2.7	2. GE Wind	US	6.0
3. Gamesa	Spain	1.9	3. Sinovel	China	5.3
4. GE Wind	US	1.3	4. Gamesa	Spain	4.4
5. Siemens	Denmark	1.1	5. Goldwind	China	3.6
6. Suzlon	India	0.9	6. Suzlon	India	3.5
7. Repower	Germany	0.9	7. Enercon	Germany	3.4
8. Goldwind	China	0.7	8. Dongfang	China	3.0
9. Nordex	Germany	0.5	9. Repower	Germany	2.9
10. Ecotecnica	Spain	0.3	9. Siemens	Denmark	2.9

■ Europe
 ■ US
 ■ China
 ■ Other Asia

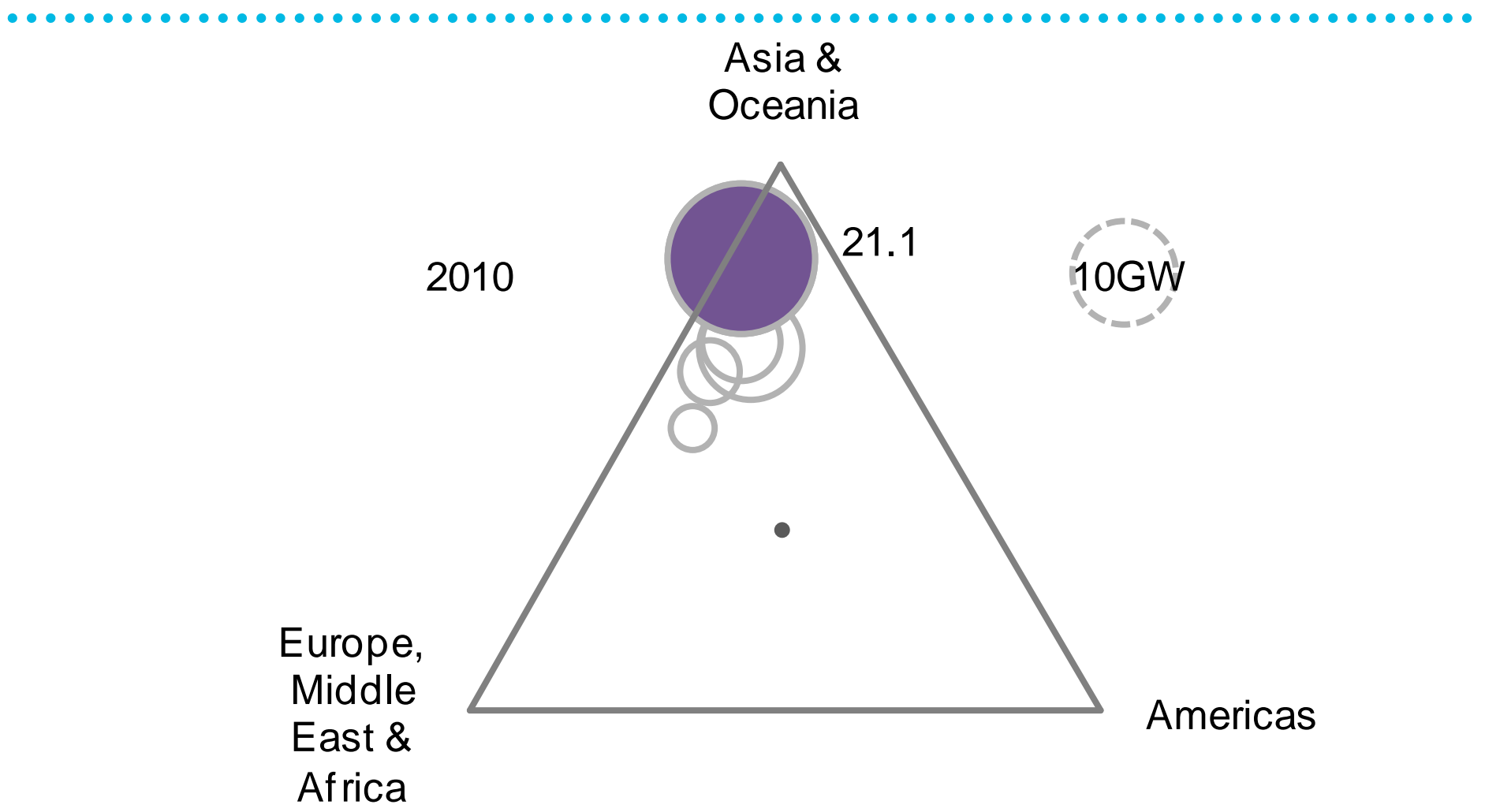
Source: Bloomberg New Energy Finance

# SOLAR MANUFACTURING CAPACITY ADDITIONS (GW)



Source: Bloomberg New Energy Finance

# SOLAR MANUFACTURING CAPACITY ADDITIONS (GW)



Source: Bloomberg New Energy Finance

# TOP 10 GLOBAL PV CELL MANUFACTURERS 2006, 2010 (RANK ORDER BY CAPACITY)

2006

+46% per year

2010

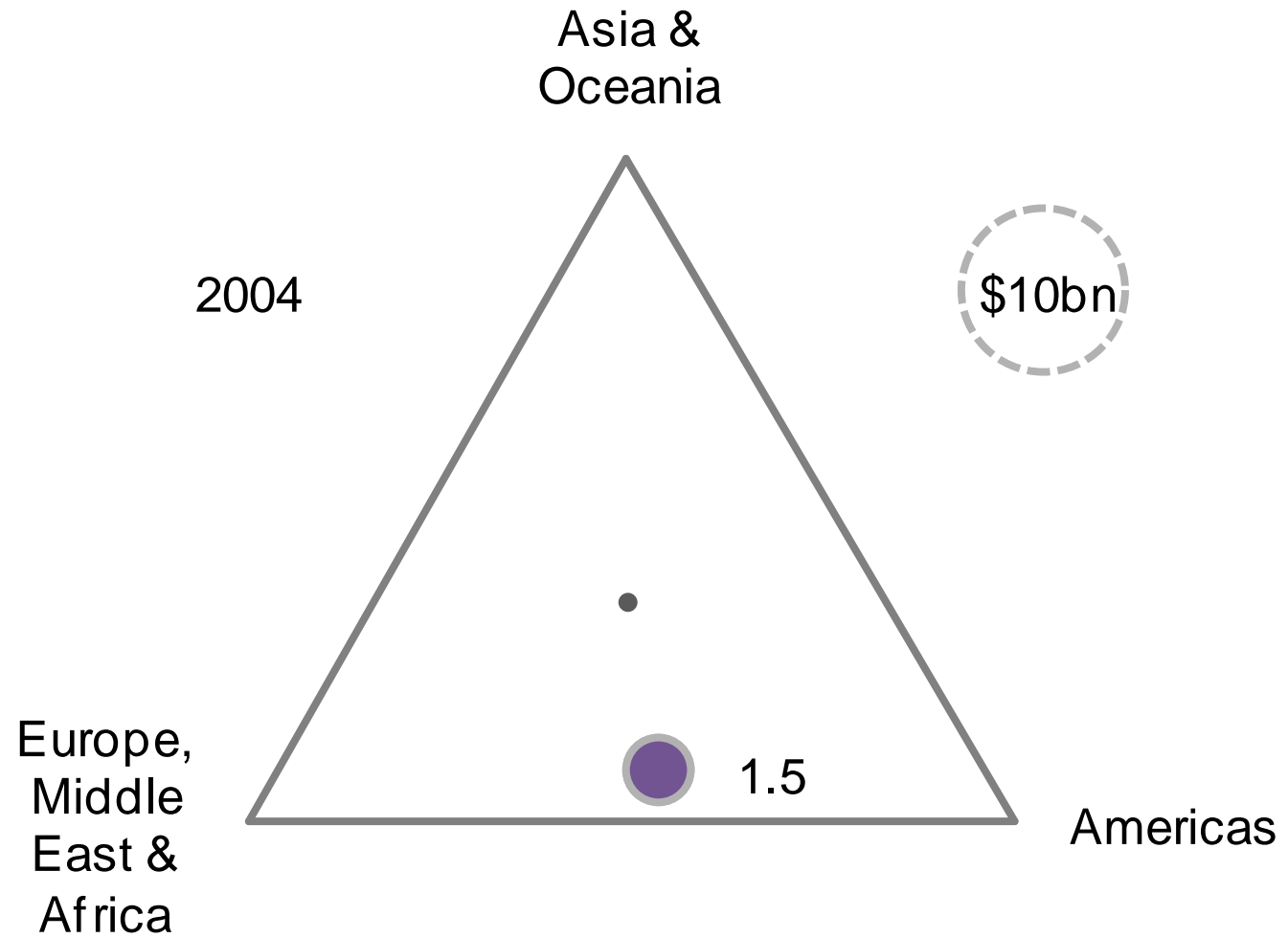
Company	Country	Capacity (MW)	Company	Country	Capacity (MW)
Sharp	Japan	500	JA Solar	China	1,900
Q-Cells	Germany	420	Suntech	China	1,620
Suntech	China	270	First Solar (TF)	US	1,502
Motech	Taiwan	240	Yingli	China	1,100
Solarworld	Germany	200	Trina Solar	China	1,000
China Sunergy	China	180	Q-Cells	Germany	1,000
Kyocera	Japan	180	Canadian Solar	China	800
Isofoton	Spain	130	Motech	Taiwan	600
Schott	Germany	121	Gintech	Taiwan	600
Sanyo Electric	Japan	115	JinkoSolar	China	600

■ Europe 
 ■ US 
 ■ China 
 ■ Other Asia

Note: 'Capacity' counted as either crystalline silicon cell or thin film module.  
TF is thin film

Source: Bloomberg New Energy Finance, company announcements

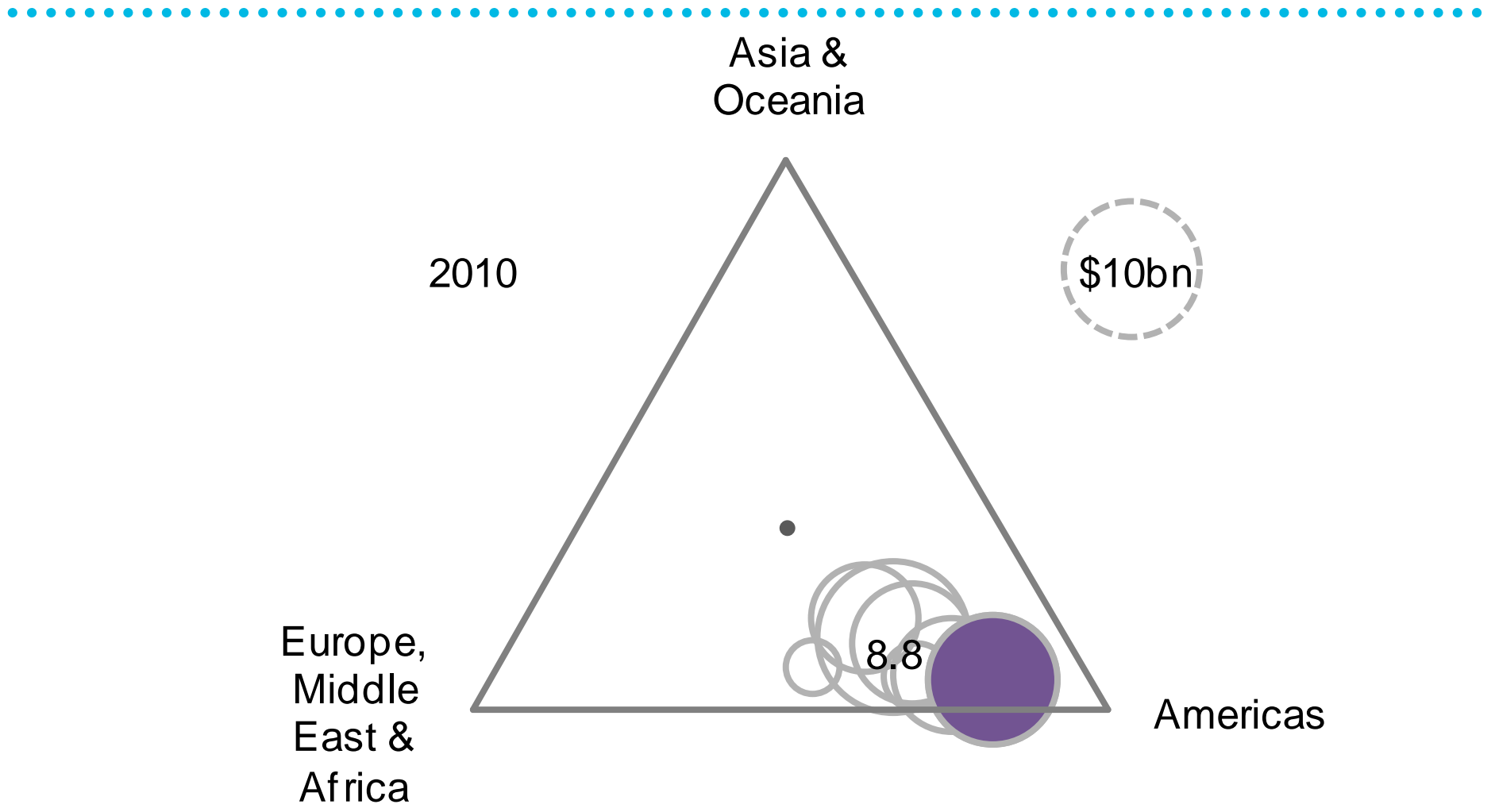
# VENTURE CAPITAL & PRIVATE EQUITY (\$BN)



Source: Bloomberg New Energy Finance



# VENTURE CAPITAL & PRIVATE EQUITY (\$BN)

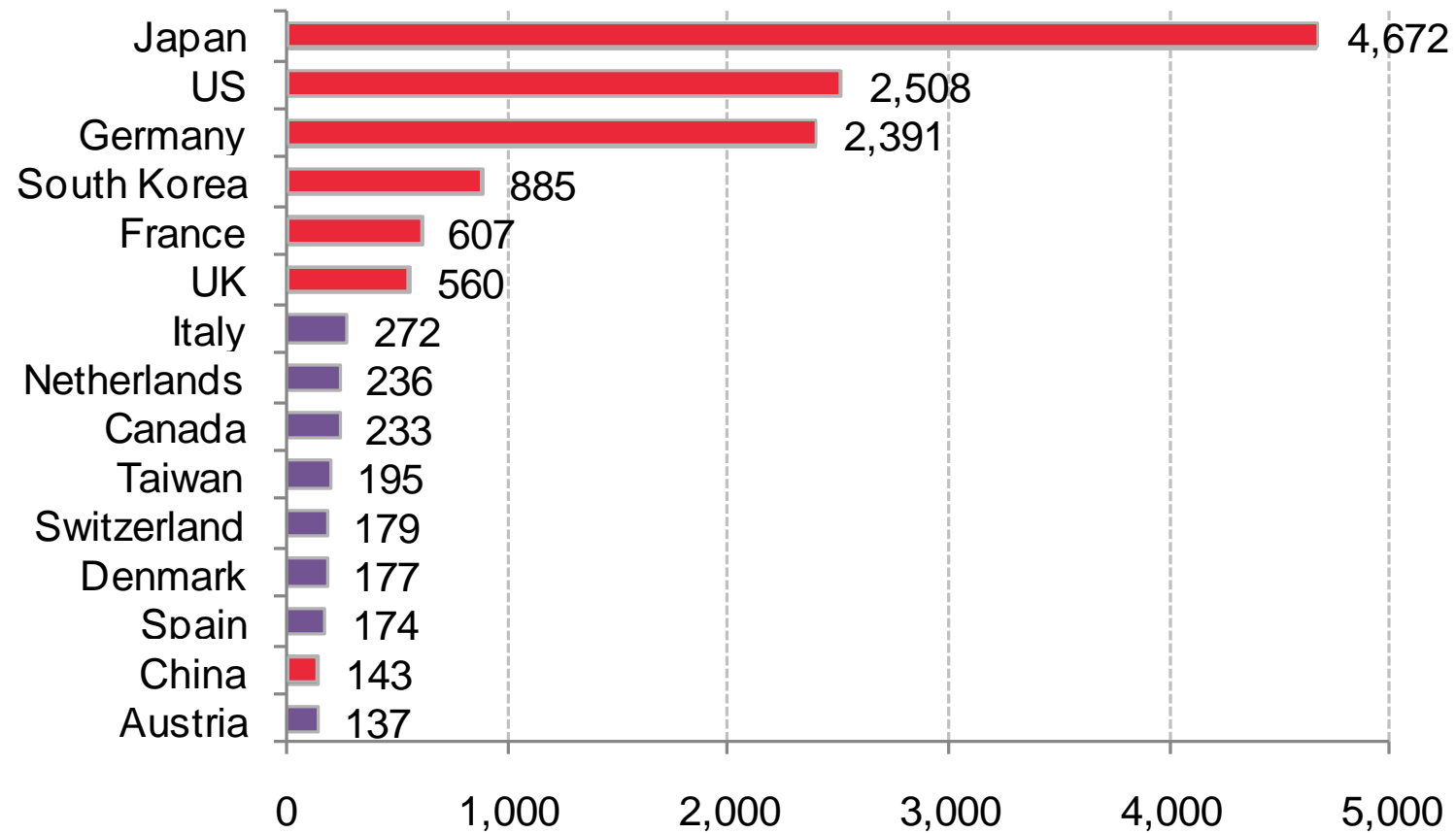


Source: Bloomberg New Energy Finance

# INTERNATIONAL CLEAN ENERGY PATENTS, 1978–2006

## TOP 15 COUNTRIES BY NO. PATENTS

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Note: Patents ordered by country of invention

Source: UNEP-EPO-ICTSD Report, Bloomberg New Energy Finance

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# GEOPOLITICAL IMPLICATIONS

## THOUGHT STARTER

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- New global corporate players
- Competition for jobs, trade tensions
- New resource constraints (rare earths, lithium)
- New economic rents & capital flows
- Shifts in trade flows
- Increased vulnerability to hacking, cyberwar, terrorism, bugs
- Cap on long-term fossil fuel prices
- Accelerating reduction in demand for coal and oil

Source: New Energy Finance

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# THANKS!

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**TWITTER: [MLiebreich](https://twitter.com/MLiebreich)**

## MARKETS

Renewable Energy

Carbon Markets

Energy Smart Technologies

Renewable Energy Certificates

Carbon Capture & Storage

Power

Water

Nuclear

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**Knowledge Services:** Summit, Leadership Forums, Executive Briefings & workshops

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